

# Claims

[c1] A self closing valve comprising:

- a valve body having a flow passage therethrough;
- a metal valve seal ring having first and second sealing surfaces disposed within the valve body about a portion of the flow passage;
- a valve member mounted within the flow passage for movement between an open position and at least one of at least two closed positions, the valve member having a seating surface for engagement with at least one of the sealing surfaces of the metal valve seal ring in at least one of the closed positions;
- a biasing element associated with the valve member for urging the valve member toward the closed positions;
- and
- the metal valve seal ring being formed as an annular ring having first and second annular fingers extending radially inwardly of the flow passage portion to provide first and second sealing surfaces spaced apart along the longitudinal axis of said portion of flow passage, the first annular finger being normally inclined toward the second annular finger and the first and second sealing surfaces each being coined to each provide a surface portion for

mating with a respective portion of the seating surface for selective sealing engagement therewith when the valve member is in a respective at least one of the closed positions.

- [c2] The valve of claim 1 wherein the seating surface of the valve member and the first sealing surface of the metal valve seal ring are in sealing engagement when force applied to the valve member is within a first force range.
- [c3] The valve of claim 2 wherein the seating surface of the valve member and the first and second sealing surfaces of the metal valve seal ring are in sealing engagement when the force applied to the valve member is within a second force range at least a portion of which second force range is different than the first force range.
- [c4] The valve of claim 1 wherein the first and second annular fingers of the metal seal ring extend radially inwardly and have a surface on their respective inner end that was coined by contact with the valve member seating surface.
- [c5] The valve of claim 4 wherein the incline of the first annular finger of the metal seal ring was formed by permanently bending the first annular finger toward the second annular finger .
- [c6] The valve of claim 1 wherein the incline of the first an-

nular finger of the metal seal ring was formed by permanently bending the first annular finger toward the second annular finger .

- [c7] A self closing valve comprising:
- a valve body having flow passage therethrough;
  - a metal valve seal ring having first and second sealing surfaces disposed within the valve body about a portion of the flow passage;
  - a valve member mounted within the flow passage for movement between an open position and at least one of at least two closed positions, the valve member having a seating surface for engagement with at least one of the sealing surfaces of the metal valve seal ring in at least one of the closed positions;
  - a biasing element associated with the valve member for urging the valve member toward the closed positions;
  - and
  - the metal valve seal ring being formed as an annular ring having first and second annular fingers extending radially inwardly of the flow passage portion to provide first and second sealing surfaces spaced apart along the longitudinal axis of said portion of the flow passage, the first and second sealing surfaces each being coined to each provide a surface portion for mating with a respective portion of the seating surface for selective sealing

engagement therewith when the valve member is in a respective at least one of the closed positions.

- [c8] The valve of claim 7 wherein the first annular finger of the metal seal ring is resiliently deformable and is inclined toward the second annular finger.
- [c9] The valve of claim 7 wherein the seating surface of the valve member and the first sealing surface of the metal valve seal ring are in sealing engagement and the seating surface of the valve member and second sealing surface of the metal valve seal are not in sealing engagement when opening force applied to the valve member is within a first force range.
- [c10] The valve of claim 9 wherein the seating surface of the valve member and the first and second sealing surfaces of the metal valve seal are in sealing engagement when opening force applied to the valve member is within a second force range, at least a portion of the second force range is different than the first force range.
- [c11] A metal valve seal ring for a valve comprising:  
an annular ring having first and second annular fingers extending radially inwardly from an outer perimeter to provide a first sealing surface on the first annular finger and a second sealing surface on the second annular fin-

ger;

the first annular finger being resiliently deformable within its range of movement in a valve and inclined toward the second annular finger; and

the first and second sealing surfaces having been formed by coining.

[c12] A metal valve seal ring for a valve comprising:  
an annular ring having first and second annular fingers extending radially inwardly from an outer perimeter to provide a first sealing surface on the first annular finger and a second sealing surface on the second annular finger; and

the first annular finger being resiliently deformable within its range of movement in a valve and being normally inclined toward the second annular finger.

[c13] The metal valve seal ring of claim 12 wherein the first annular finger incline having been formed by bending the first annular finger.

[c14] A check valve comprising:  
a valve body having a flow passage therethrough,  
a metal valve seal ring having first and second sealing surfaces disposed within the valve body about a portion of the flow passage;  
a valve member mounted within the flow passage for

movement between an open position and at least one of at least two closed positions, the valve member having a seating surface for engagement with at least one of the sealing surfaces of the metal valve seal ring in at least one of the closed positions; and  
the metal valve seal ring being formed as an annular ring having first and second annular fingers extending radially inwardly of the flow passage portion to provide first and second sealing surfaces spaced apart along the longitudinal axis of said portion of flow passage, the first annular finger being normally inclined toward the second annular finger and the first and second sealing surfaces each being coined to each provide a surface portion for mating with a respective portion of the seating surface for selective sealing engagement therewith when the valve member is in a respective at least one of the closed positions.

[c15] The check valve of claim 14 wherein the seating surface of the valve member and the first sealing surface of the metal valve seal ring are in sealing engagement when opening force on the valve member fluid pressure is relatively low.

[c16] The check valve of claim 15 wherein the seating surface of the valve member and the first and second sealing surfaces of the metal valve seal ring are in sealing en-

gagement when opening force on the valve member is relatively high.

[c17] A check valve comprising:  
a valve body having a flow passage therethrough,  
a metal valve seal ring having first and second sealing surfaces disposed within the valve body about a portion of the flow passage;  
a valve member mounted within the flow passage for movement between an open position and at least one of at least two closed positions, the valve member having a seating surface for engagement with at least one of the sealing surfaces of the metal valve seal ring in at least one of the closed positions; and  
the metal valve seal ring being formed as an annular ring having first and second annular fingers extending radially inwardly of the flow passage portion to provide first and second sealing surfaces spaced apart along the longitudinal axis of said portion of the flow passage, the first and second sealing surfaces each being coined to each provide a surface portion for mating with a respective portion of the seating surface for selective seating engagement therewith when the valve member is in a respective at least one of the closed positions.

[c18] The check valve of claim 17 wherein the first annular finger of the metal seal ring is resiliently deformable and is

inclined toward the second annular finger.

[c19] The check valve of claim 17 wherein the seating surface of the valve member and the first sealing surface of the metal valve seal ring are in sealing engagement when opening force on the valve member is relatively low.

[c20] The check valve of claim 19 wherein the seating surface of the valve member and the first and second sealing surfaces of the metal valve seal ring are in sealing engagement when opening force on the valve member is relatively high.

[c21] A relief valve comprising:  
a valve body having a flow passage therethrough;  
a metal valve seal ring having first and second sealing surfaces disposed within the valve body about a portion of the flow passage;  
a valve member mounted within the flow passage for movement between an open position and at least one of two closed positions, the valve member having a seating surface for engagement with at least one of the sealing surfaces of the metal valve seal ring in at least one of the closed positions;  
a spring associated with the valve member for urging the valve member toward the closed positions; and  
the metal valve seal ring being formed as an annular ring



having first and second annular fingers extending radially inwardly of the flow passage portion to provide first and second sealing surfaces spaced apart along the longitudinal axis of said portion of the flow passage, the first and second sealing surfaces each being coined to each provide a surface portion mating with a respective portion of the seating surface for selective seating engagement therewith when the valve member is in a respective at least one of the closed positions.

[c22] The relief valve of claim 21 wherein the first annular finger of the metal valve seal ring is resiliently deformable and is normally inclined toward the second annular finger.

[c23] The relief valve of claim 22 wherein the seating surface of the valve member and the first sealing surface of the metal valve seal ring are in sealing engagement when opening force on the valve member is within a first force range.

[c24] The relief valve of claim 23 wherein the seating surface of the valve member and the first and second sealing surfaces of the metal valve seal ring are in sealing engagement when opening force on the valve member is within a second force range at least a portion of the second force range is greater than the first force range.

[c25] A self closing valve comprising:

- a valve body having a flow passage therethrough;
- a metal valve seal ring having first and second sealing surfaces disposed within the valve body about a portion of the flow passage;
- a valve member mounted within the flow passage for movement between an open position and at least one of at least two closed positions, the valve member having a seating surface for engagement with at least one of the sealing surfaces of the metal valve seal ring in at least one of the closed positions;
- a biasing element associated with the valve member for urging the valve member toward the closed positions;
- and
- the metal valve seal ring being formed as an annular ring having first and second annular fingers extending radially inwardly of the flow passage portion to provide first and second sealing surfaces spaced apart along the longitudinal axis of said portion of flow passage, the first annular finger being normally inclined toward the second annular finger and the first and second sealing surfaces each providing a surface portion for mating with a respective portion of the seating surface for selective sealing engagement therewith when the valve member is in a respective at least one of the closed positions.

- [c26] The valve of claim 25 wherein the first annular finger is inclined at a normal angle of incline of at least about 5°.
- [c27] The valve of claim 26 wherein the normal angle of incline is at least about 10°.
- [c28] The valve of claim 25 wherein the first and second annular fingers of the metal seal ring extend radially inwardly and have a surface on their respective inner end that was coined by contact with the valve member seating surface.
- [c29] The valve of claim 28 wherein the incline of the first annular finger of the metal seal ring was formed by permanently bending the first annular finger toward the second annular finger.
- [c30] The valve of claim 25 wherein the incline of the first annular finger of the metal seal ring was formed by permanently bending the first annular finger toward the second annular finger.